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(54) Device and Procedure for Testing Heavy Capacity Scales

(72) Karpa, Michael J.,
Canada

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ABSTRACT:

A device and procedure for testing heavy capacity scales by providing a means for accurately loading such scale platforms by using a simple load cell incorporating arrangement thrusting against the scale and reacting from the scale baseplate supports or from the foundation footings. By loading each cell over its maximum working range the scale can be calibrated and subsequently checked for accuracy and re-calibrated by adjusting the individual cell outputs. Mechanical scales can also be tested using this device and are adjusted as if the above thruster were stacked dead weight test weights.

This invention relates to a simple device and procedure for accurately setting up heavy capacity scales (such as truck and track scales) and for subsequently checking and re-adjusting such scales to maintain their accuracy of weight determination.

Normally in setting up or calibrating any heavy capacity scale installation dead weights of known certified weight are used. For scales of large capacity (such as 100,000 lbs and over truck scales and rail track scales) it is common practice to use known test weights amounting to a fraction of the scale capacity - 20,000 lbs, for example, for truck scales. After the scale is adjusted to indicate correctly the test weight value, substitute dead weight material (of about the same weight as the test weight) is placed on the scale and the test weight is used as an addition to set up the scale further up its capacity range. This procedure is repeated until the scale has been set up or calibrated all the way up to its capacity. This same procedure is not only used on new installations but to periodically check scales which are in service.

This substitution procedure has some inherent disadvantages and limitations as follows:

(1) The handling, transportation and maintenance of 20,000 lbs of test weights is quite a costly item with modern test trucks costing about $100,000.00. Furthermore with modern heavier capacity truck scales (100 tons becoming not rare) 20,000 lbs of test weights is generally thought to be insufficient. For track scales test cars of known weight must be used in addition.

(2) The dead weight substitution material is usually difficult to obtain at most sites particularily in the ideal

20,000 lbs increments. There is also normally at least one graduation of uncertainty in th substituted material weight value.

(3) The procedure of handling test weights and substituting dead weight material is quite time consuming and the problem arises of being able to differentiate between errors of weighing and normal zero movement due to temperature changes, etc. which occur on all electronic scales with the elapse of time.

The present invention overcomes these drawbacks by using a relatively simple reactive loading device incorporating a calibrated load cell with indicator and a means of generating a thrust or force against the scale platform. The cost of this loading arrangement is a small fraction of the cost of a fully equipped test truck or test car; the load cell used in the device could be the customer's spare unit consequently the method is easily affordable for all scale owners. The principle behind this simple test idea lies in the demonstratable fact that for scales of a proven or approved design type the test for accuracy can be reduced to one of loading each support point (for load cell scales loading over the load cell) in turn over a range equal to the maximum load that each point can receive under the worst possible scale full load condition. If under such loading the scale indicates true weight (force) values for all supports it will indicate correct values no matter what the overall platform loading pattern or load distribution. For some special scales it may be necessary to load cells in pairs; also rough checks can be quickly done by loading cells in pairs or even in groups of 4. When testing scales of a new design it is additionally

required to determine the affects of load location, platform deflection and other factors on the scales ability to weigh accurately. This, however, need only be done on one prototype of a new scale type or perhaps a new installation to check workmanship and/or faulty material in the bridge structure itself. The majority of scale tests or annual inspections of scales of proven or approved type design can be tested by the method according to this invention. The device and procedure according to this invention permits all support points to have their full range tested quickly thus eliminating environmental influences such as temperature affects on zero, wind on built up weights, etc. It should also be noted that variations in gravity (changes with altitude) will affect this method of scale testing. However the change in "g" in a normal scale area produces negligible errors.

The device according to this invention consists essentially of a mechanical thruster in the form of a column or strut which incorporates a calibrated load cell standard and a hydraulic loading jack or similar. The lower end of this thruster reacts against the platform normally at a support point and the upper end is restrained by a reaction block which is attached by tension members to the base plate anchor bolts, or the support base or to the foundation footing. The jack develops the platform loading force and the load cell which is connected to a calibrated readout instrument accurately indicates the amount of load. A pressure guage in the hydraulic system gives a rough force indication which may be used for strain and overload tests but is not accurate enough for legal for trade class calibration. It is very important that the load is introduced

without the simultaneous presence of side forces hence a relatively long strut with hinged or free ends is used. To ensure that the loading column is thrusting in a direction not inclined to the horizontal (i.e. vertical) a number of different type levelling devices can be used. For cases where provision has not been made for attaching the tension members to the support base plate area the upper reaction block is made to react against a beam which straddles the scale platform and attaches to the foundation footings at each end. A similar reaction beam is required when the load cells are mounted outboard of the platform.

The present invention will now be described with reference to the accompanying drawing with like components having the same numbers in the different alternatives.

Figure 1 shows the loading device over a load cell with the reaction block fastened to the support baseplate anchor bolts.

Figure 2 shows essentially the same arrangement as Fig. 1 but deployed over a mechanical scale support pivot.

Figure 3 shows a side view of the loading device on a typical scale platform cross-section with the reactive beam connected to the foundation footing.

Figure 4 shows an arrangement similar to Fig. 3 with a reactive beam, outboard cells and connections to the cell base plate anchor bolts.

In Fig. 1 we have a loading device located over a support of a low profile scale platform 1 which rests on a series of pairs of load cells one of which is shown as 2. Said cells 2 rest on a foundation footing 3 which has anchor bolts 4 imbedded in it. Fastened to the upper threaded part of these bolts 4 is a nut 16 which is welded to a

tension rod 17 which pass through clearance holes in the platform and have their other end fastened to an upper reaction block 18. Between the platform 1 and the upper block 18 is located the loading assembly consisting of a rubber or wood distribution block 8 with a load adaptor 9 on top incorporating a spherical seat 10 one part of which is fastened to a precision load cell 11. A cylindrical hydraulic jack 12 with a ram extension 13 and another spherical seat assembly 14 completes the loading assembly. All that is further required now is to connect the load cell 11 to a calibrated readout and accurate loading can be done by actuating the hydraulic jack 12. Fixed on the side of the ram extension 13 we have a bubble type level 15 which enables one to make necessary adjustments so that the platform is loaded vertically. The spherical assemblies 10 and 14 ensure that negligible horizontal forces are introduced to the platform 1.

Fig. 2 shows essentially the same device as in Fig. 1 but located over a typical mechanical scale pivot assembly 19.

Fig. 3 we have a loading device with the same loading column elements as in Figs. 1 and 2 with the exception that the upper reaction block 18 is now replaced by using a horizontal beam member 7 . To develop the reactive force for the upper block 18 we have a beam 7 which straddles the platform 1 and has its end attached to cables 6 which attach by threaded clevises 5 to anchor bolts 4 imbedded in the foundation footing 3.

Fig. 4 shows an arrangement similar to Fig. 3 used for scales with outboard mounted load cells 2. The cable 6 and its attached clevis 5 are affixed to the anchor bolt 4.

Said anchor bolt 4 is imbedded in the foundation footing 3 is also used to hold down the load cell baseplate 20.

Although the invention has been described with reference to some specific embodiments a number of details can be altered without affecting the basic principle of the concept. For example in place of the compression load cell 11 in the loading column one could use 2 tension cells in the tension rods or cables, in fact a single tension cell in one of the tension members and precise spacing of the active and reactive force lines would work as well. Furthermore by varying the spacing between the tension cell and load point vs dummy tension member and load point it becomes possible to use a tension cell of greatly reduced rating. The hydraulic jack could be replaced by a power screw; the cross beam 7 in Figs. 3 and 4 can be a light truss type structure; and the anchor bolts 4 could be a variety of concrete lifting insert devices commercially available. It is not necessary to attach the tension members to the support baseplate anchor bolts as the system would work just as well connected to any rigid detail (baseplate itself, base of load cell, load cell mounting bolts, etc.) in the support area. As far as the procedure is concerned the loading can be simplified by arranging the loading thruster between load cell pairs or one loading point for a 4 cell scale platform panel; the scale testing procedure would be greatly speeded up with some loss of calibration accuracy.

The embodiment of the invention in which an exclusive property or privelege is claimed are defined as follows:

1. A device for accurately loading heavy capacity scales for purposes of determining their accuracy, said scales comprising a load receptacle, with a plurality of well defined support points, load sensing mountings and a supporting foundation; said device to be deployed at various locations over a scale under test and said device consisting of:

(a) a loading column having an upper and a lower end and incorporating a calibrated load cell,

(b) said loading column incorporating a force generating means to develop the column load,

(c) a means for ensuring that said loading column is vertically positioned during loading,

(d) having the lower end of said loading column thrusting against the scale load receptacle through a hinged or pivoting joint,

(e) having the upper end of said loading column thrusting against a reaction block through a hinged or pivoting joint,

(f) with the said reaction block fastened to a load sensing mounting or supporting foundation by tension members, and

(g) a means for precisely reading out the load in the loading column load cell by known means.

2. A device of claim 1 but wherein the scale load receptacle comprises a loading frame or platform for highway trucks or rail guided vehicles.

3. A device of claim 1 or 2 but wherein a tension load cell is used in one of the tension members instead of

the compression load cell in the loading column.

4. A device of claim 1 or 2 but wherein a tension load cell is used in each of the tension members instead of the compression load cell in the loading column.

5. A device of claim 1 or 2 wherein the force generating means is a hydraulic jack.

6. A device of claim 1 or 2 wherein the force generating means is a mechanically leveraged device.

7. A device of claim 6 wherein the mechanically leveraged device is a power screw.

8. A device of claim 6 wherein the mechanically leveraged device is a wedge.

9. A device of claim 1 or 2 but wherein the force is developed in the loading column by incorporating a pulling device into one of the tension members holding the loading device to a load sensing mounting or supporting foundation.

10. A procedure for accurately loading heavy capacity scales using the device of claim 1 or 2 wherein said device is deployed in turn over each support point and loaded to the maximum support point capacity.

11. A procedure for accurately loading heavy capacity scales using the device of claim 1 or 2 wherein the loading procedure is simplified so that support points are loaded in pairs to their maximum capacity.

12. A procedure for accurately loading heavy capacity scales using the device of claim 1 or 2 wherein the loading procedure is further simplified so that the scale support points are loaded in multiple groupings that correspond to a scale section or panel with the loading taken to the corresponding capacity.

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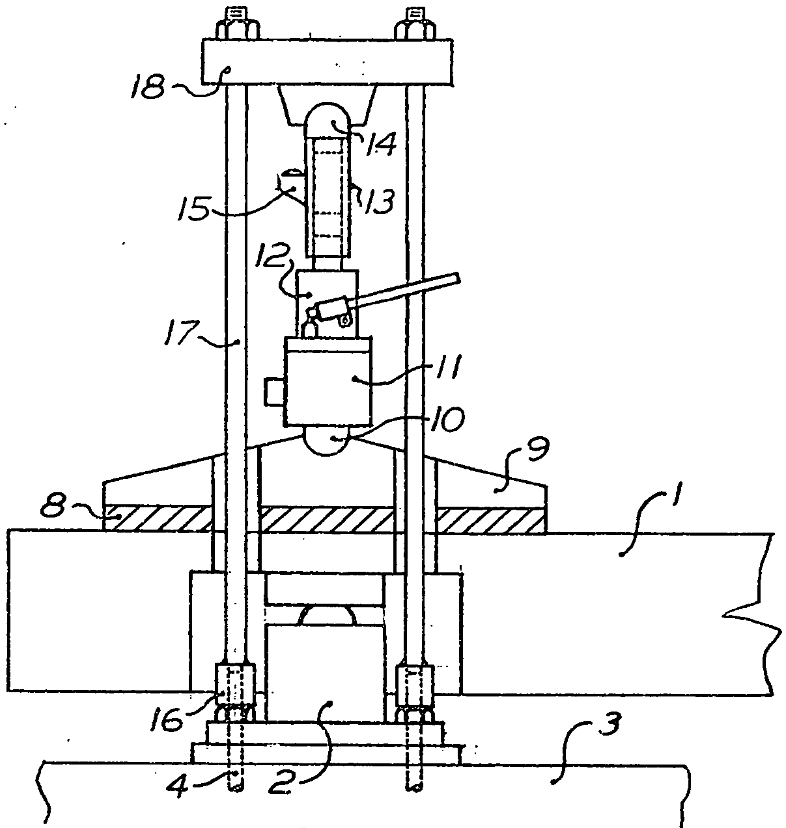

FIG. 1

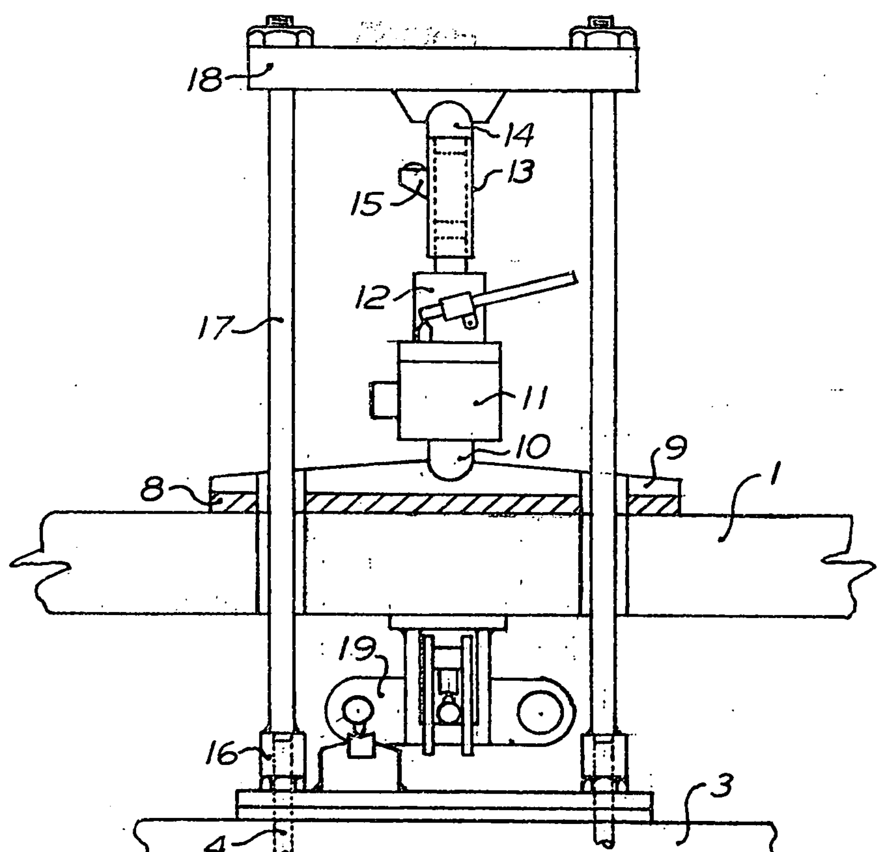

FIG. 2

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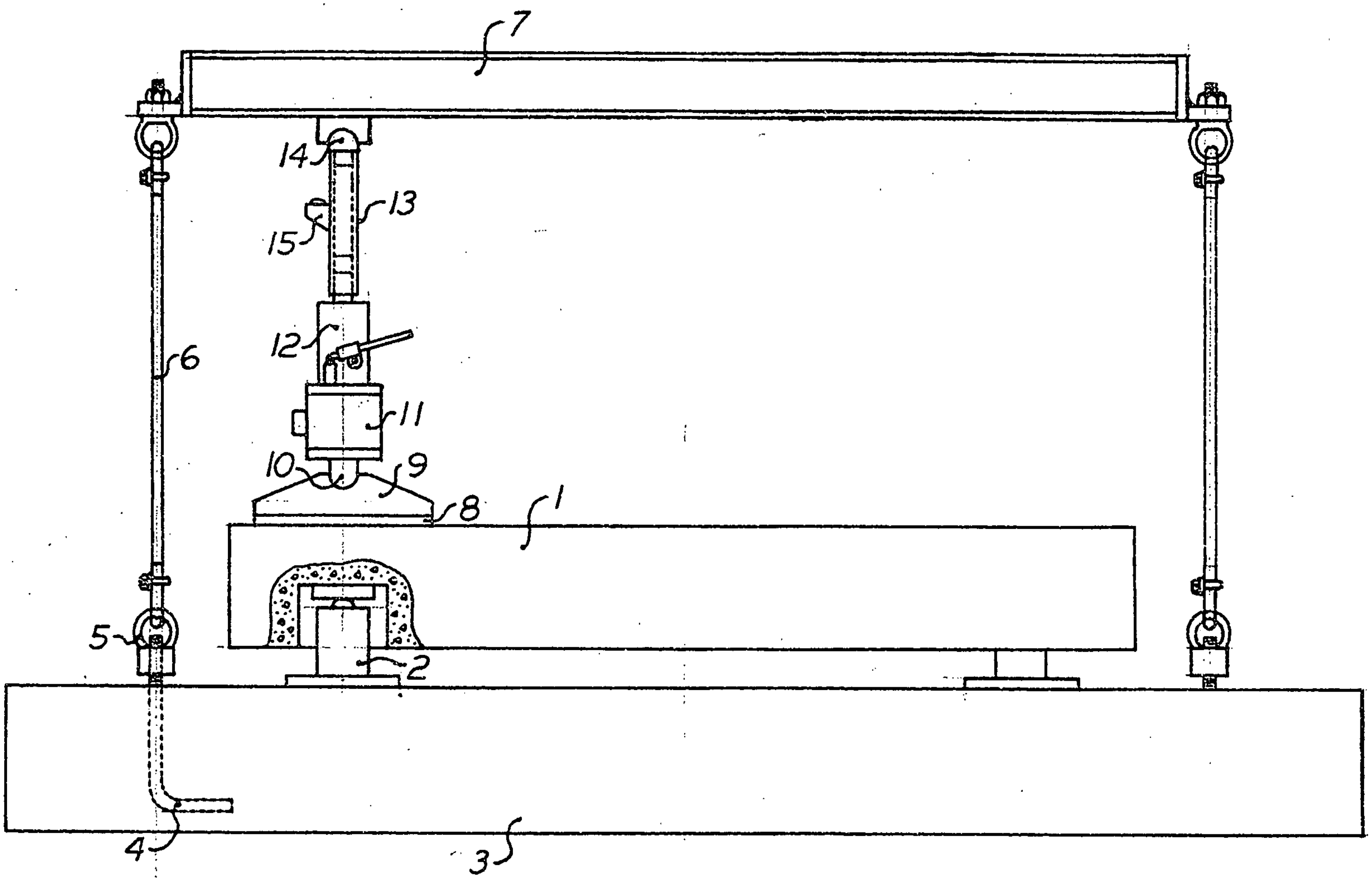

FIG. 3

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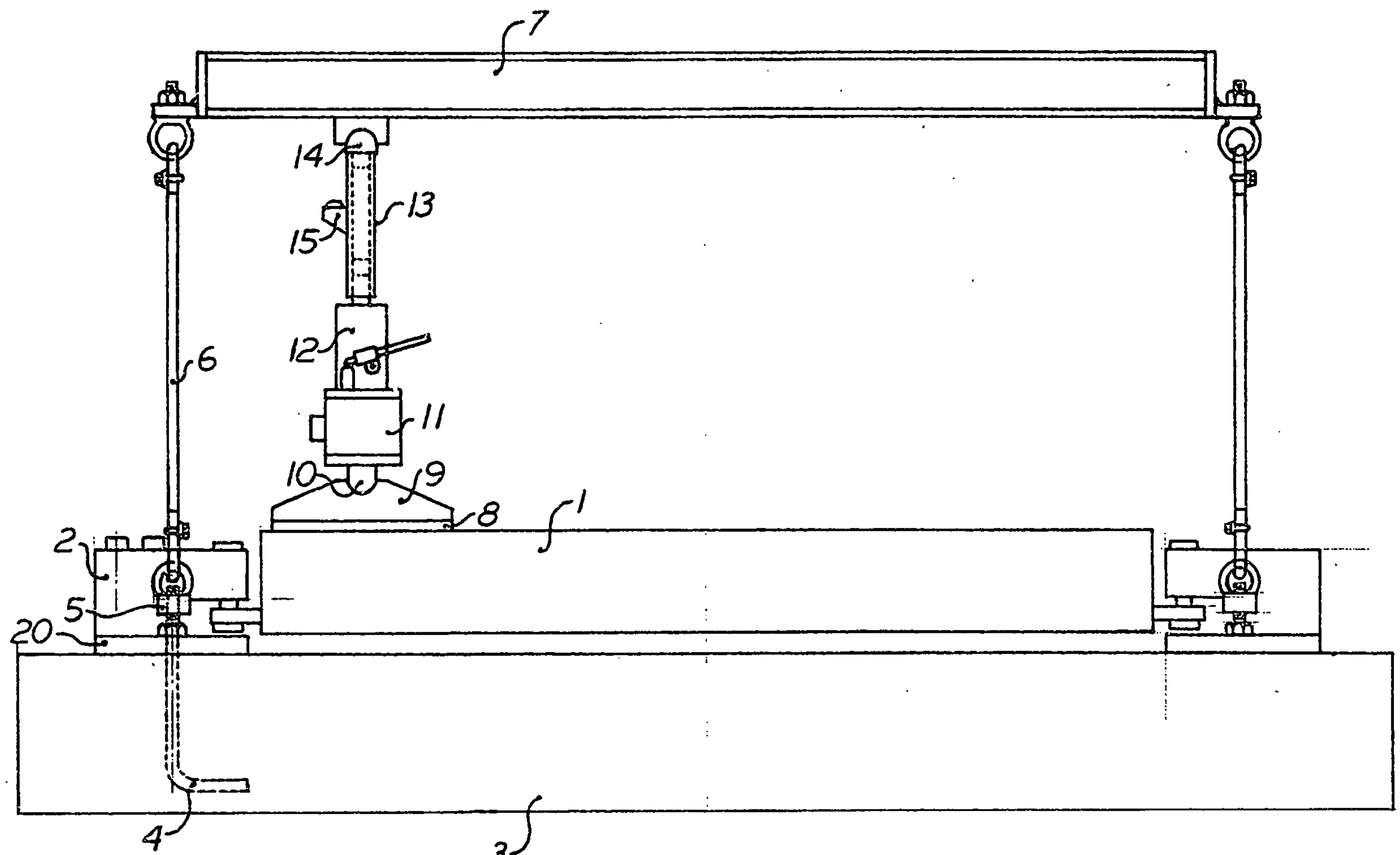

FIG. 4

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